REMARKS

I. Introduction

In response to the Office Action dated July 28, 2004, claim 2 has been amended. Claims 1-23 remain in the application. Entry of this amendment is requested.

II. Allowable Subject Matter

In paragraph (4), the Office Action indicates that the subject matter of claims 13-15, 17, 19, 21 and 23 would be allowable if written in independent form including all of the limitations of the base claim and any intervening claims. The Applicants acknowledge the Office Action's indication of allowable subject matter, but traverse the rejection of the remaining claims.

III. The Cited References and the Subject Invention

A. The Lee Reference

U.S. Patent No. 5,874,915, issued February 23, 1999 to Lee et al. disclose a wideband cylindrical UHF array. A wideband electronically scanned cylindrical array includes an array of end-fire radiating elements, the elements arranged in a first plurality of columns, the columns arranged radially about a center axis of the array. A beamforming network is connected to the array of radiating elements. The beamforming network includes a power divider circuit for dividing an input RF drive signal into a second plurality of drive signals, and a matrix of electronically controlled transfer switches. A true time delay network comprising a third plurality of delay lines couples respective ones of the drive signals to the matrix of transfer switches. A third plurality of transmit amplifiers is coupled to the matrix of transfer switches, each amplifier for amplifying a respective one of the drive signals. The beamforming network further includes apparatus for coupling the amplified drive signals to selected ones of the columns of radiating elements. A beamforming controller is connected to the coupling apparatus and the matrix of transfer switches for selecting sectors of the columns of radiating elements to be driven by the drive signals to form a desired beam. The columns of radiating elements are arranged in a circularly symmetric fashion about the axis in the disclosed embodiment.

B. The Dent Reference

U.S. Patent No. 6,377,558, issued April 23, 2002 to Dent discloses a multi-signal transmit array with low intermodulation. A transmitter is provided for simultaneously transmitting a plurality of signals in a plurality of directive beams to corresponding destination stations, each destination station located in a separate fan within a service area. The transmitter includes a plurality of beamformers, each beamformer receiving one of the signals to be transmitted to an associated fan, each of the beamformers having a plurality of outputs for each different signal to be transmitted. A plurality of Butler matrices each receive one of the plurality of outputs from the plurality of beamformers for each different signal to be transmitted, each Butler matrix having a plurality of outputs in phased relationship to one another, wherein each of the signals to be transmitted is simultaneously provided across the outputs of each Butler matrix in a phased relationship. An antenna is provided with an aperture within which a two-dimensional array of antenna elements are disposed, wherein equal fractions of adjacent antenna elements are connected to the outputs of each Butler matrix, and wherein each of the plurality of signals are simultaneously transmitted by the entire two-dimensional array of antenna elements. Each of the plurality of beamformers receives steering control signals for steering the direction of each beam within its respective fan.

C. The Subject Invention

A transponder system that integrates redundancy and beam selection capabilities is disclosed. The transponder system comprises an amplifier network having a plurality of amplifiers; an antenna network, comprising a plurality of antennae; an output switching network, including a first output switching network switch, selectably coupling one of the amplifiers to one of the plurality of antennae at a first output switching network switch first switch state and to a second output switching network switch in a first output switch network switch second switch state, wherein the second output switching network switch is selectably coupled to a second one of the plurality of antennae in a second output switching network switch first switch state and to a third one of the plurality of antennae in a second output switching network switch second switch state.

IV. <u>Office Action Prior Art Rejections</u>

In paragraphs (1)-(2), the Office Action rejected claims 1-10, 18, 20, and 22 under 35 U.S.C. § 102(b) as being anticipated by Lee et al., U.S. Patent No. 5,874,915 (Lee). The Applicants respectfully traverse those rejections.

<u>With Respect to Claim 1</u>: Claim 1 recites:

> *An transponder system, comprising:*
> *an amplifier network having a plurality of amplifiers;*
> *an antenna network, comprising a plurality of antennae;*
> *an output switching network, including a first output switching network switch, selectably coupling one of the amplifiers to one of the plurality of antennae at a first output switching network switch first switch state and to a second output switching network switch in a first output switch network switch second switch state; and*
> *wherein the second output switching network switch is selectably coupled to a second one of the plurality of antennae in a second output switching network switch first switch state and to a third one of the plurality of antennae in a second output switching network switch second switch state.*

According to the Office Action, the first output switch of the output switching network is disclosed as switch 141A of FIG. 5 (reproduced below). The Applicants respectfully disagree. Claim 1 recites that the first output switching network switch selectably couples one of the amplifiers (which the Office Action indicates is disclosed by element 120A) to one of a plurality of antennae when in a first switch state. A review of FIG.5 reveals that this is incorrect. The switches that selectably couple one of the amplifiers to one of the plurality of antennae are switches 110.

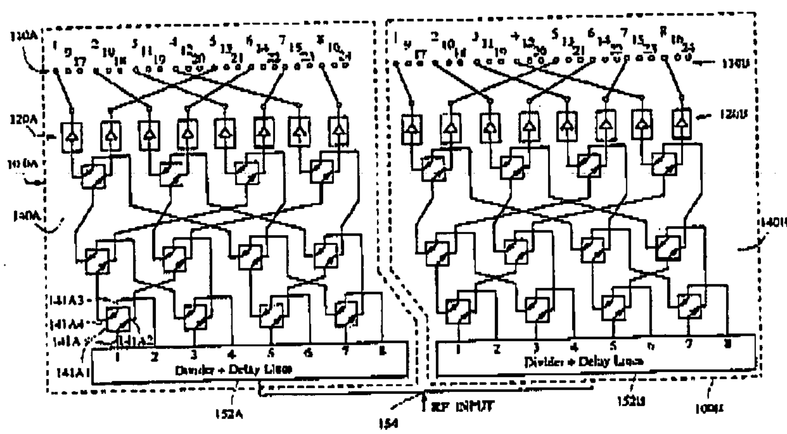

FIG. 5

Claim 1 further recites that the first output switching network switch couples one of the amplifiers to another second switch when in the second switch state. This feature is met by neither switch element 110 nor switch 141A.

The Office Action also suggests that the features

> "wherein the second output switching network switch is selectably coupled to a second one of the plurality of antennae in a second output switching network switch first switch state and to a third one of the plurality of antennae in a second output switching network switch second switch state"

are disclosed as follows:

> FIG. 4 is a schematic of the beamforming network 100 for the transmit and receive modes for the array 50. The feed network 100 includes a high power, low loss commutation switch matrix 110 to switch the beam around the azimuth plane. For this embodiment, there are 16 switches 1101-1116, each for selectively connecting a port on one side of the switch to one of three ports on a second side of the switch. Thus, for example, switch 1101 selectively connects the port 1101A to one of three ports 1101B-1101D. This provides the capability to selectively connect to one of three columns of radiating elements in the array. In this exemplary embodiment, the selector switch 1101 is for selectively connecting the feed network to one of columns 601, 617 and 633 comprising the array.
>
> The network 100 further includes an array 120 of 16 transmit/receive (T/R) modules, each module including a T/R switch, a transmit module including a high power transmitter, and a low noise amplifier. For example, exemplary module 1201 includes T/R switch 1201A, transmit amplifier 1201B, and low noise receive amplifier 1201C. The switch connects the radiating element side of the module to either the transmit amplifier (transmit mode) or to the low noise receive amplifier (receive mode). The outputs of the receive amplifiers are sent to a digital beamformer (not shown). The inputs to the transmit amplifiers are from the network 130 of low power phase shifters which provides the capability of fine steering in azimuth. There are 16 phase shifters 1301-1316 comprising the network 130.
>
> The network 100 further includes a 16.times.16 matrix 140 of transfer switches, connected between the fixed delay line network 150 and the 1:16 power divider 160 which receives the RF input signal for the transmit mode. The matrix 140 has 16 output ports connected to the network 150, and 16 input ports connected to the divider 160. For wideband operation a time delay feed network 150 is included, for connecting the RF drive signal from the power divider to the transfer switches. There are 16 delay lines 1501-1516 comprising the time delay feed network; each of the delay lines is fixed and common to all beam positions. In conjunction with the 1:3 commutation switches 1101-1116 at the output, the (16.times.16) transfer switch matrix correspondingly maps these delay lines into the 16 columns on the array circle to equalize the differential time delays for any beam direction. In this exemplary embodiment, the equalization of differential time delays is employed to produce a set of possible beams, each having a planar energy wavefront, e.g. as shown in FIG. 1. There are 48 beam positions in total with 7.5 degrees per step, thus providing overlapping coverage in azimuth and 360 degree coverage. Using this switch matrix 140, 16 of the 48 columns of end-fire elements can be fed for any given beam direction with the same fixed time delay network. The purpose of the switch matrix 140 is to equalize the time delay for any of the possible beam directions, by selectively connecting the fixed time delay lines to the columns selected by the selector switches 110. The selector switches 110 serve to select the appropriate columns to form a beam in a desired direction.
>
> The elements of the feed network 100 can all be physically contained in the radome 30. The power divider 160

can, for example, be a pillbox circuit or Rotman lens, each of which is well known in the art.

The switches 110 and 140, phase shifters 130, and the T/R switches are electronically controlled by the system controller 170. The switching time, less than 10 microseconds, is accomplished by the electronic switches comprising the switch matrix 140 and the selector switches 110. No scan loss is incurred by circular symmetry as opposed to other designs where triangular or four-face planar arrays might be used.

The solid state array 50 can operate at a higher duty cycle (>25%) than the known mechanically scanned system, so the peak power will be much lower. Also, because transmit loss is reduced, the solid state design alleviates the high voltage breakdown and maintenance problems encountered in mechanically scanned systems. The beamforming network includes fixed delay lines for wide band performance, and the system is supplemented with low power phase shifters for refined beam scan. On receive, digital beamforming with photonic links may be used to provide azimuth (AZ) and EL beam agility through adaptive nulling. 16 or 48 channels of fiber optic links may be used for signal and data remoting. Antenna remoting and signal processing using photonic links at UHF is relatively easy to achieve at low cost.

Each sector of columns selected by the selector switches 110 in this exemplary embodiment includes 16 columns, to generate an energy wave front as shown in FIG. 1. A planar wave front can be generated, because time delays in signal propagation times are corrected by differential line lengths in the lines comprising the network 150.

FIG. 5 is a schematic diagram showing an exemplary feed network 100 for the array system 50, comprising two identical sub-networks 100A, 100B used to feed the 16 columns of the array selected by the selector switches. Sub-network 100A includes the 8.times.8 switch matrix 140A, the set of transmit modules 120A and the set of selector switches 110A. Sub-network 100B includes the switch matrix 140B, the set of transmit modules 120B and the set of selector switches 110B. The switches comprising the matrices 140A, 140B are double pole, double throw switches. Thus, for example, switch 141A has terminals 141A1-141A4. In a first switch position shown in FIG. 5, terminal 141A1 is connected to terminal 141A2, and terminal 141A4 is connected to terminal 141A3. In the second switch position, terminal 141A1 is connected to terminal 141A3, and terminal 141A4 is connected to terminal 141A2. (col. 3, line 33 - col. 5, line 4)

The Applicants respectfully disagree, as they cannot find any structure in the foregoing discussion that is analogous to the structure recited in claim 1.

<u>With Respect to Claim 18</u>: Claim 18 recites:

> *A method of providing a signal to any one of a plurality of output devices, comprising the steps of:*
> *receiving the signal in a first switch;*
> *selectably coupling the signal to a first output device or a second switch via a first switch according to a first switch selection; and*
> *selectably coupling the signal from the first switch to a second output device or a third output device if the signal is not coupled to the first output device via the second switch according to a second switch selection.*

According to the Office action, the foregoing features are disclosed in the same way as is described above with respect to claim 1. The Applicants disagree for the same reasons.

<u>With Respect to Claim 20</u>: Claim 20 recites:

An apparatus for providing a signal to any one of a plurality of output devices, comprising:
a first switch for receiving the signal and for selectably coupling the signal to a first output device or a second switch via the first switch according to a first switch selection; and
a second switch for selectably coupling the signal from the first switch to a second output device or a third output device if the signal is not coupled to the first output device via the second switch according to a second switch selection.

According to the Office action, the foregoing features are disclosed in the same way as is described above with respect to claim 1. The Applicants disagree for the same reasons.

In paragraph (3), the Office Action rejected claims 11-12 and 16 under 35 U.S.C. §102(e) as being anticipated by Dent, U.S. Patent No. 6,377,558 (Dent). The Applicants respectfully disagree.

With Respect to Claim 11: Claim 11 recites:

A network, comprising:
an first device network having a plurality of first devices;
a second device network, having a plurality of second devices;
a single rail output switching network, communicatively coupling any of the second devices with any of the first devices.

According to the Office Action, the single rail output switching network communicatively coupling any of the second devices with any of the first devices is disclosed by:

"a plurality of Butler matrix rows 91-95 each connects amplifiers 85 to antenna elements 90; col. 6, line 48 - col. 7, line 35"

The cited portions of the Dent reference are reproduced below:

FIG. 5 depicts a transmitter, indicated generally as 80, for transmitting multiple independently steerable beams using the whole antenna array aperture. The transmitter 80 includes an antenna aperture array 82, columns 84a–84n of power amplifiers 85, beamformers 86a–86n, and a signal router 88. The antenna aperture array 82 includes antenna elements 90 grouped in rows, with each row connected to a respective passive coupler or Butler matrix, and more specifically, matrix 91 for row one, matrix 92 for row two, matrix 93 for row three, matrix 94 for row four, and matrix 95 for row five. The Butler matrices 91–95 each have a number of inputs, usually but not necessarily equal to the number of outputs connected to the antenna elements 90. Each of the Butler matrix inputs are indicated with the corresponding Butler matrix reference number followed by a–n, while each of the Butler matrix outputs are indicated with the corresponding Butler matrix reference number followed by a'–n'.

Each input signal to each Butler matrix is split between the outputs in a manner different from, and orthogonal to, the manner in which signals at the other inputs are split. For instance, input signal 91a is split across outputs 91a'–91n' in a first manner; input 91b is split across outputs 91a'–91n' in a second manner; etc.

In the simplest form of a two-input, two-output Butler matrix, a signal presented to the first input may be split in two, in-phase, half-power copies at the outputs, while the signal presented at the second input is split out-of-phase.

A four-input, four-output Butler matrix splits the signals presented at respective inputs in the phase-sequences:

	Output Phases			
Input 1:	0°	0°	0°	0°
Input 2:	0°	90°	180°	270°
Input 3:	0°	180°	300°	540°
Input 4:	0°	270°	540°	810°

The signals to successive inputs split with a phase incremented successively through multiples of an incremental phase; in the above example the phase increments are a multiple of 90°. The incremental phase shift being 0° for Input 1, 90° for Input 2, 180° for Input 3, and 270° for Input 4.

Referring again to FIG. 5, the Butler matrices 91–95 are eight-input, eight-output Butler matrices which accordingly use phase increments which are a multiple of 45°. More specifically, the Butler matrices 91–95 split the signals presented at respective inputs in the following phase-sequences:

	Output Phases							
Input 1:	0°	0°	0°	0°	0°	0°	0°	0°
Input 2:	0°	45°	90°	135°	180°	225°	270°	315°
Input 3:	0°	90°	180°	270°	360°	450°	540°	630°
Input 4:	0°	135°	270°	405°	540°	675°	810°	945°
Input 5:	0°	180°	360°	540°	720°	900°	1080°	1260°
Input 6:	0°	225°	450°	675°	900°	1125°	1350°	1575°
Input 7:	0°	270°	540°	810°	1080°	1350°	1620°	1890°
Input 8:	0°	315°	630°	945°	1260°	1575°	1890°	2205°

The Applicants respectfully traverse. The Office Action's rejection appears to be based on the notion that a Butler matrix is necessarily a single rail output switching network. That is not the case. As described in U.S. Patent No. 4,356,461, a Butler Matrix is not typically a single rail output switching network:

> Referring first to FIG. 1, an 8×8 Butler matrix 10 which comprises the basic building block of an embodiment of the present invention has eight input ports (K) designated 11 through 18 and having the K designations 0, +4, -2, +2, -1, +3, -3 and +1, respectively. There are eight output ports (J) designated 21 through 28 and having the J designations 0, 4, 1, 5, 2, 6, 3 and 7, respectively. This Butler matrix is comprised of twelve 180° hybrids 30 through 41, three 90° fixed phase shifters 44, 45 and 46, a 45° fixed phase shifter 47 and a 135° fixed phase shifter 49.

The hybrid convention is illustrated at FIG. 2, reference to which should now be made. A typical hybrid of the type used in the 8×8 matrix of FIG. 1 has an undotted input port 52a, a dotted input port 52b, an undotted output port 52c and a dotted output port 52d. A signal at undotted input port 52a is split into two equal amplitude, in-phase signals, at output ports 52c and 52d, respectively. A signal at dotted port 52b is split into two equal amplitude signals at the output ports, where the signal at dotted output port 52d is phase shifted 180° with respect to the input signal and the signal at the undotted output port 52c.

Returning to FIG. 1, Butler matrices generally and the Butler matrix of FIG. 1 and their operation are well known to those skilled in the art. Briefly, Butler matrices are generally passive and reciprocal microwave devices. With respect to the 8×8 matrix illustrated, a signal into any K input port results in signals of equal amplitude and a linear phase gradient at the J output ports. The phase gradient is determined by which input port is excited. For example, it can be seen that if input port 11 (K port 0) is energized the resulting signals at the output ports are in-phase. If input port 14 (K port +2) is energized the phase gradient across the J output ports (J ports 0, 1, . . . 7) is +90°, while if input port 13 (K port -2) is energized the phase gradient across the J output ports is -90°. Thus, the phase gradient mathematical relationship presented above is satisfied, using the K and J port numbers, and assuming .theta.ₖ and .theta.ₒ are zero, a valid assumption as will be explained below. (col. 2, line 60 - col. 3, line 32)

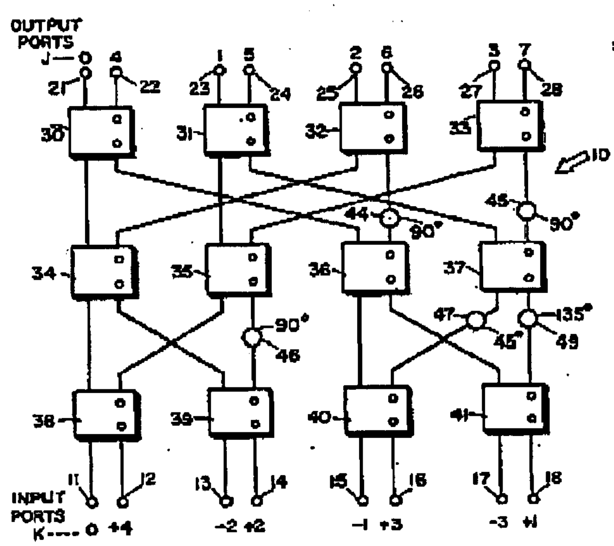

FIG. 1

Accordingly, the Dent reference does not teach the features of the Applicants claims, and the Applicants respectfully traverse these rejections

V. Dependent Claims

Dependent claims 2-10, 12-17, 19, 21, and 23 incorporate the limitations of their related independent claims, and are therefore patentable on this basis. In addition, these claims recite novel elements even more remote from the cited references. Accordingly, the Applicants respectfully request that these claims be allowed as well.

VI. Conclusion

In view of the above, it is submitted that this application is now in good order for allowance and such allowance is respectfully solicited. Should the Examiner believe minor matters still remain that can be resolved in a telephone interview, the Examiner is urged to call Applicants' undersigned attorney.

Respectfully submitted,

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